REMARKS OF

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AT THE

CONFERENCE ON SELECTED TECHNOLOGY FOR
THE ELECTRIC POWER INDUSTRY

LEWIS RESEARCH CENTER
NASA

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I am glad to have this opportunity to add my welcome to Dr. Silverstein's and to say a few words to you this evening, at the mid-point of the conference on "Selected Technology for the Electric Power Industry."

In working with the Edison Electric Institute, the Cleveland Electric Illuminating Company, and others to arrange this conference, Dr. Silverstein and his associates have been carrying out one of NASA's most important

functions. We in NASA do not regard our job as limited to the development of the nation's capabilities in aeronautics and space, although we are working hard at it.

We also have the duty to explore with others the meaning of activities we are charged with carrying out and how these activities can be of maximum benefit throughout our political and economic system. In all we do we seek not only to accomplish the primary objective, but also to maximize the second and third order benefits and search out ways all three can work to the best advantage of the nation as a whole. We are continually exploring with the Department of Defense the ways in which our capabilities in aeronautics and space and in the development of advanced technology can contribute to national defense. We are likewise in regular consultation with the Department of State on the ways in which aeronautical and space technology can be used constructively in the support of foreign policy objectives. We have had a continuous dialogue over the years with the leaders of the nation's universities and have actively experimented in ways in which we can conduct our activities so as to increase the strength and capabilities of the universities at the same time that they make their unique contributions to science, technology and other fields.

In addition, and of equal importance, we have the obligation and have taken as an important objective the sharing with American industry of the technological advances which in many respects are the most tangible

products of our work. We have done this through the distribution of publications, through the establishment of regional dissemination centers like the one at the University of Indiana, and at meetings and conferences, like this one, with industry groups directed at the topics likely to be of the greatest interest to them. NASA's plants and facilities, at this beginning of the second decade of the Space Age, a capital asset of great value to our nation, at cost it stands at more than $4 billion. As a government organization utilizing large additional industry facilities and work forces, we have shown we could rapidly build up a national effort requiring an annual rate of expenditure that went to just under $6 billion a year and is now something above $4 billion. It is particularly significant that over 90 per cent of the work is being done outside the government installations.

This, then, is the broader pattern of which this conference is a part. As technical managers from electric power companies and their major equipment suppliers, I hope that you are finding the information being presented to you on NASA's research and development activities in propulsion, power generation, systems reliability, and other fields of interest and of possible use in your work. I hope that, at the same time, the conference will help focus your attention on the broader question of the role of advanced technology in the development of our national economy and of our position in the world. What the U.S. and other nations are doing in aeronautics and space is changing fundamentally the ingredients of national power, both economical and political. The meaning of these changes and the opportunities

they provide for the future are not always entirely clear and are difficult to assess. It is important that the thinking people in industry, as well as those in universities, government, and the public at large assess this meaning and these opportunities and give careful consideration to them.

Much has been accomplished in the first ten years of space. We have progressed from launch vehicles capable of putting only three pounds in orbit to the Saturn V, which can put 140 tons in orbit. We have progressed from a time when launch failures were common occurences to a time when our overall launch success rate has exceeded 85 per cent.

In the Mercury and Gemini programs, we have accumulated almost 2,000 hours of manned flight in space. This experience has provided insights into the effects of weightlessness on the human metabolism as well as other biological information without which the manned exploration of space cannot proceed. These flights also established the capability for rendezvous and docking and taught us much about man's ability to work in space. Next month, with Apollo 7, we will resume manned flights. This will be the beginning of a series of earth orbital flights using the advanced Saturn-Apollo system in a sequence which we expect will enable us to demonstrate a manned landing on the moon, perhaps near the end of next year.

As we have pressed forward with the manned flight effort, we have also conducted a varied sequence of unmanned scientific and technology

development flights, the cumulative effect of which has been to make fundamental changes in our view of the Earth, its environment, its relationship to the sun, our knowledge of the other nearby bodies in the solar system, and our ability to put this knowledge to new uses.

One of these efforts has been the exploration of the moon. This began with the Ranger photographs of the lunar surface just before they crashed into it. Ranger was followed by the Lunar Orbiters and the Surveyor spacecraft which produced thousands of high-resolution photographic studies of different areas of the moon, including the dark side, as well as close-ups of the lunar topography. We now have precise information regarding the bearing strength of the moon's surface. We now know its structure and have collected data relating to its chemical composition.

The flybys of Venus and Mars have taught us much about those planets. The missions of Mariners II and V to the vicinity of Venus have caused a revision of ideas about the nature of that cloud-wrapped planet and its environment. We now think of its atmosphere as being very much denser than earth's -- perhaps as much as a hundred times -- and with surface temperatures that may exceed 800 degrees F. From more than a hundred million miles in space, Mariner IV sent back pictures of the surface of Mars taken from a range of 6,000 miles. They showed a Martian surface pitted with craters. Mariner IV also reported an attenuated Martian atmosphere and detected no magnetic field.

Less publicized than these missions, but no less significant, have been the wide variety of unmanned scientific satellites flown to examine the environment around the earth: its ionosphere, magnetosphere, and the Van Allen radiation belts. Other satellites have examined and reported on the sun, the solar environment and the solar wind. Included in these groups were the Explorers, the Pioneers, the Orbiting Solar and the Orbiting Geophysical Observatories.

The cumulative product of these missions has been a deeper understanding of the nature and behavior of the environment of earth and space and the manner in which they interact. We now know that some of these phenomena influence, perhaps decisively, our communications capability and our weather and perhaps probably other elements of our daily life.

Our work in Space Sciences has gone hand in hand with the application of space capabilities to very important practical needs. Meteorological satellites have not only advanced our scientific understanding of the atmosphere but have become a standard part of our national system of weather forecasting. The Weather Bureau of the Department of Commerce is now responsible for procurement and operation of operational meteorological satellites developed and launched for them by NASA on a reimbursable basis. This is a good example of how NASA works as a research and development agency to advance our technology and capabilities in space, and then turns over the product to others to use in their business or governmental activities.

The same pattern has been followed in communications, where concepts developed and demonstrated by NASA have been taken over by the Department of Defense and incorporated into an operational system for military use, and by the Communications Satellite Corporation for use in the INTELSAT system for general commercial use.

I am sure that your visit here at the Lewis Laboratory has already reminded you that not all of NASA's effort is devoted to space. Aeronautics -- "the study of the problems of flight with a view to their practical solution" as the act establishing our predecessor agency the NACA put it -- is an extremely important part of our activities. We have contributed fundamental technical knowledge to and done wind tunnel and other testing in support of every military aircraft the United States has ever had. Our work at the present time, in addition to supporting military requirements, is directed at the special problems of commercial aviation, including noise reduction, handling and control problems, short and vertical take-off aircraft, and the supersonic transport.

The common demoninator in all this work is advanced scientific knowledge and its evolution into usable technology. The importance to this country of a strong continuing program in aeronautics and space rests on both the direct benefits to be obtained -- in national power, scientific knowledge, and practical applications -- and on our need for continuous progress at the forward cutting-edge of technology so that in future years the most advanced technologies will be available to our economy and to meet our requirements for national defense.

We have had to face in recent years the fact that the nation is facing many difficult problems -- the war in Viet Nam, the problem of the cities, and others. In this situation it has been understandable and probably inevitable that decisions have been made by the President and by Congress that we should pull back, for financial reasons, from the steps we might have taken to make full use of the capacity and know-how we built up at great cost and establish ourselves as the clear world leader in space and aeronautics. With a capability to launch as many as six Saturn V launch vehicles per year, we have successively had to lower our goals to four per year, then to two per year, and now, under our interim plan for the present year, we have had to terminate production of both the Saturn IB and the Saturn V after completion of those now on order.

The true "cost" of these actions will be measured in future years, I am afraid, not only by the opportunities we have lost, and the high cost of re-establishing large booster production lines, but by the time, the anxiety, and the doubts of our ability which will attend a position of being forced in the 1970's to try to catch up from behind as we had to ten years ago.

While I do not minimize the serious consequences that will flow from the national decisions which have been made regarding our aerospace programs, there are a number of significant elements of strength in our present position. One such strength is that the events of the past few months -- while they have not led to levels of support needed -- nevertheless have shown there does exist a strong, continuing core of important support.

When one considers the whole array of problems facing Congress and the nation, it is significant that Congress has stood firm at the four billion dollar level for the NASA budget. I think it shows a recognition of the necessity for the country to stay in business in aeronautics and space research. I believe that the recent trend of reduced budgets for NASA will undoubtedly be reversed as the values of the program to the nation and the risks of a second-best position are better understood.

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such as this Lewis Center, is that the U. S. can count on success in building up again to the needed levels with a facilities base in the NASA aerospace complex that has cost more than four billion dollars. We clearly have the know-how in industry and a competence in science which can be put to work again when the time comes. We also have a management competence in large scale organized efforts which can restore moth-balled facilities to operational status with a minimum delay when the decision is made.

The most important element of strength is the fact that NASA and its industrial partners are still very much in business. To paraphrase Mark Twain, "the reports of the demise of the space program are greatly exaggerated."

Under our interim operating plan, which brings us $100,000,000 below the amounts appropriated by Congress as part of the $6 billion reduction ordered to effect the recent tax increase, we will

-- Move steadily ahead with the Apollo program, with two manned earth orbital flights still to come this year. If all goes well we could have five more manned flights next year and attempt a lunar landing near the end of the year.

-- Send spacecraft to fly-by Mars in 1969, and to orbit that planet in 1971. We also hope to gain support next year for a mission to land instruments on Mars in 1973, although the scope and value of the mission will be less than we had planned.

-- Continue a high level of work in aeronautics and practical space applications.

-- Proceed with a program of scientific exploration of space but at a reduced level. Among other things, we will be "listening-in" on the universe on wavelengths not accessible to us on earth with the Radio Astronomy Explorer Satellite launched last July and similarly will be "seeing" the sun and stars in ways they have not been seen before with the Orbiting Astronomical Observatory to be launched in a few weeks.

-- Finally, and perhaps most importantly, we will continue, with some reductions, a strong program on advanced research and technology in the many disciplines and fields of greatest concern in space and aeronautics--fields which are also of broader interest and value, as you are finding in your visit to this laboratory.

What you have seen and will be seeing here at Lewis is just a small sample of NASA's activities and of its contributions to technological advances.

I hope you will all at some time have the opportunity to visit our other centers and become acquainted with the many other facets of our work.

For example, those of you who are interested in turbines will want to see the turbopumps on the F-1 engines of the Saturn V. The turbopump on each of the five F-1 engines on the Saturn V produces 55,000 brake horsepower, weighs 3,000 pounds, spins at a speed of 5,500 RPM, and pumps propellants at a rate of about 40,500 gallons per minute. One of these pumps could fill an Olympic size swimming pool in about 8 minutes.

But it is not enough to be impressed by the size and performance of our large rockets, spacecraft, and facilities, or the complexity of equipment involving unbelievable numbers of minor electronic circuits. Men of your knowledge and experience will recognize that a whole revolution in technology is what we are dealing with and that the skill and ability with which it is managed is as essential to its success as the quality of the materials and the correctness of the engineering. It has been a matter of great and continuing concern to NASA's leaders that we place as much emphasis on management as we do on the technical and scientific aspects of our work. We are doing all we can to use the experimental approach in management matters as well as in science and engineering. We have also extended invitations to experts in management--both academic and

practical -- to review with us our management practices, the history of our successes and our failures, and to help us all learn together how, in fact, the large scale endeavors of our time can best be managed.

In closing, let me note that advanced technology and the ability to manage large scale endeavors are two of the most important prerequisites for this nation to be able to cope successfully with many problems of the future. It is our purpose in NASA to do our job in such a way as to contribute all we can to the advancement of both technology and management. I hope that your visit here and this conference will assist you in your endeavors and in forming your own views and judgments on ours. Thank you.